

# Tree rings in Phosim

PACCD telecon, 5/12/2014

Ben Beamer (Stony Brook)  
Andrei Nomerotski (BNL)

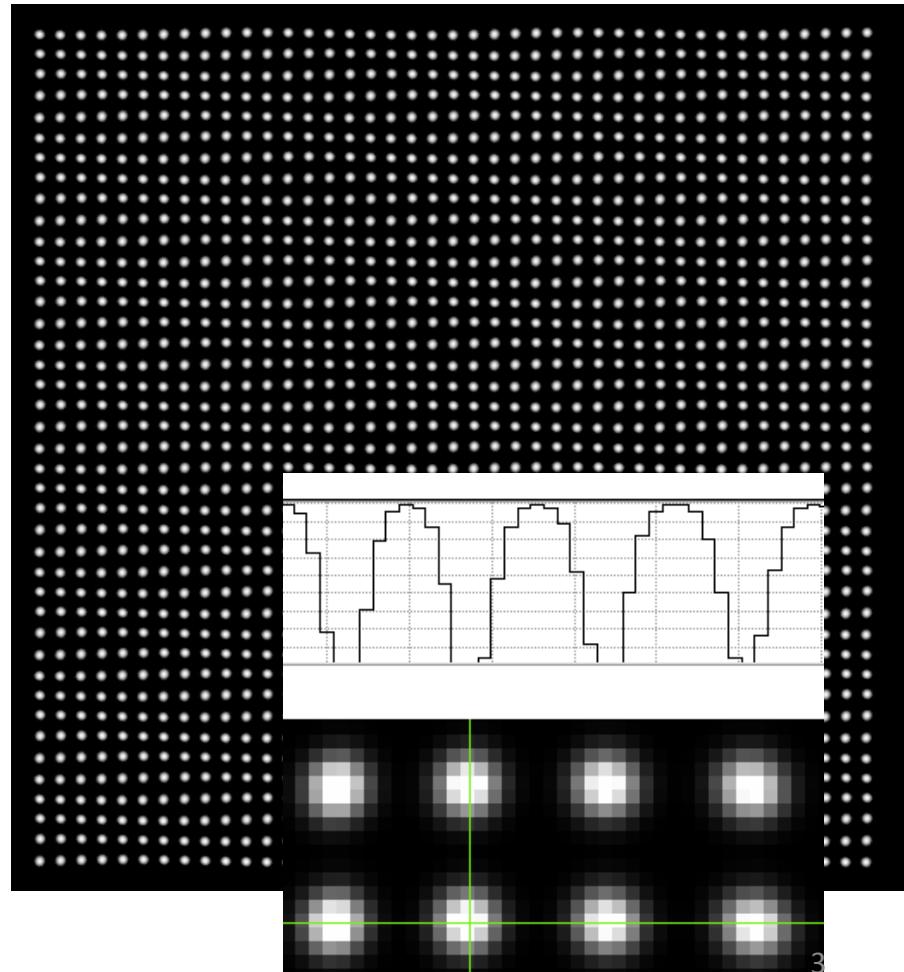
# LSST: sensor simulations

## Goals:

- Validation of main sensor effects in PhoSim
  - Regular meetings (J.Peterson)  
<https://confluence.slac.stanford.edu/display/LSSTDESC/PhoSim+Telecons>
  - Tree rings, edge effect (BNL – Nomerotski et al)
  - Brighter-Fatter effect (Duke – Walter et al)
  - Waiting list of other effects
- Simulations of lab setups, comparison to measurements
  - UC Davis LSST simulator in PhoSim (Tyson, Wei Cui et al)
  - BNL flats and spot projector
- Use tuned simulations to evaluate sensor effects on WL science (spurious shear, chromatic effects, correction algorithms etc)

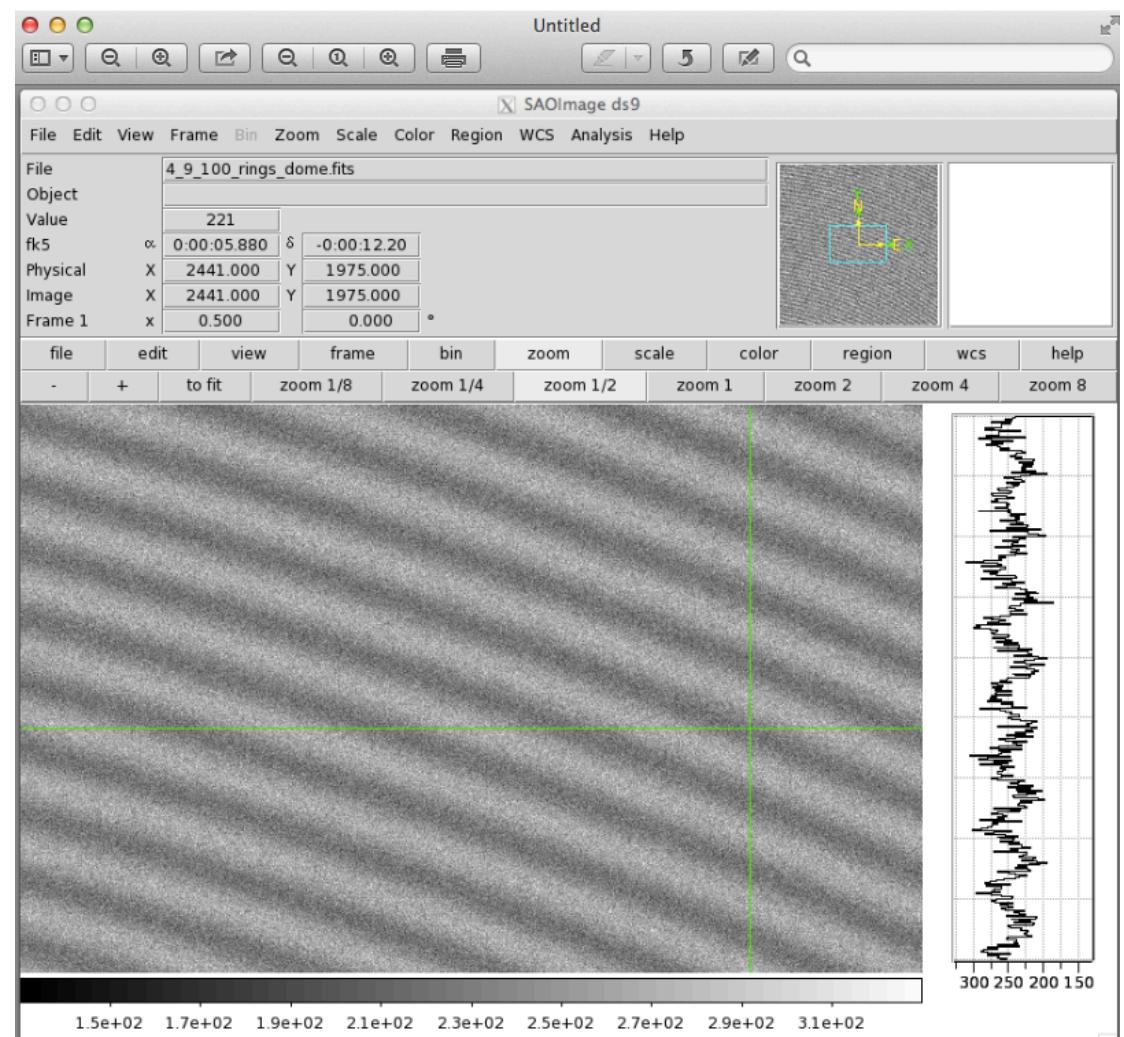
# Star field

- Generated 41x41 star field using Phosim
- Tree rings and diffusion in Si are ON
  - Period 100 pixels
- Optics and atmosphere are OFF



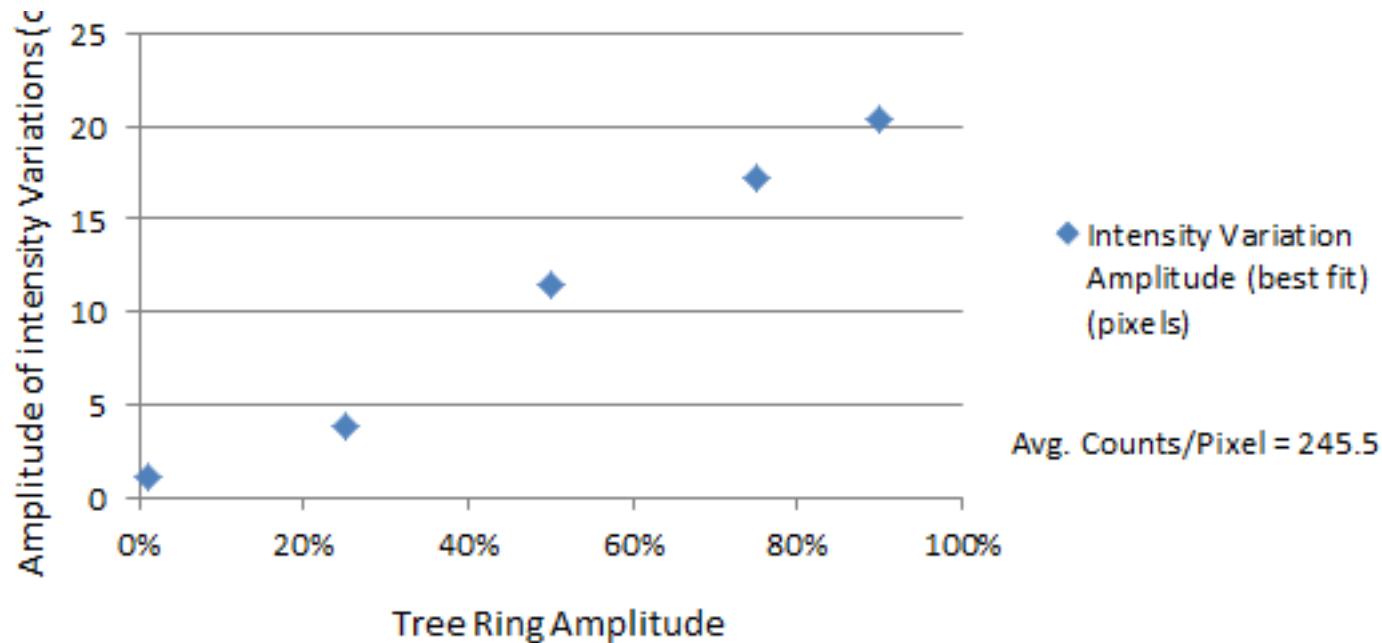
# Tree ring amplitude

Doping variation: sine function with period of 100 pixels and amplitude  $A + dA$



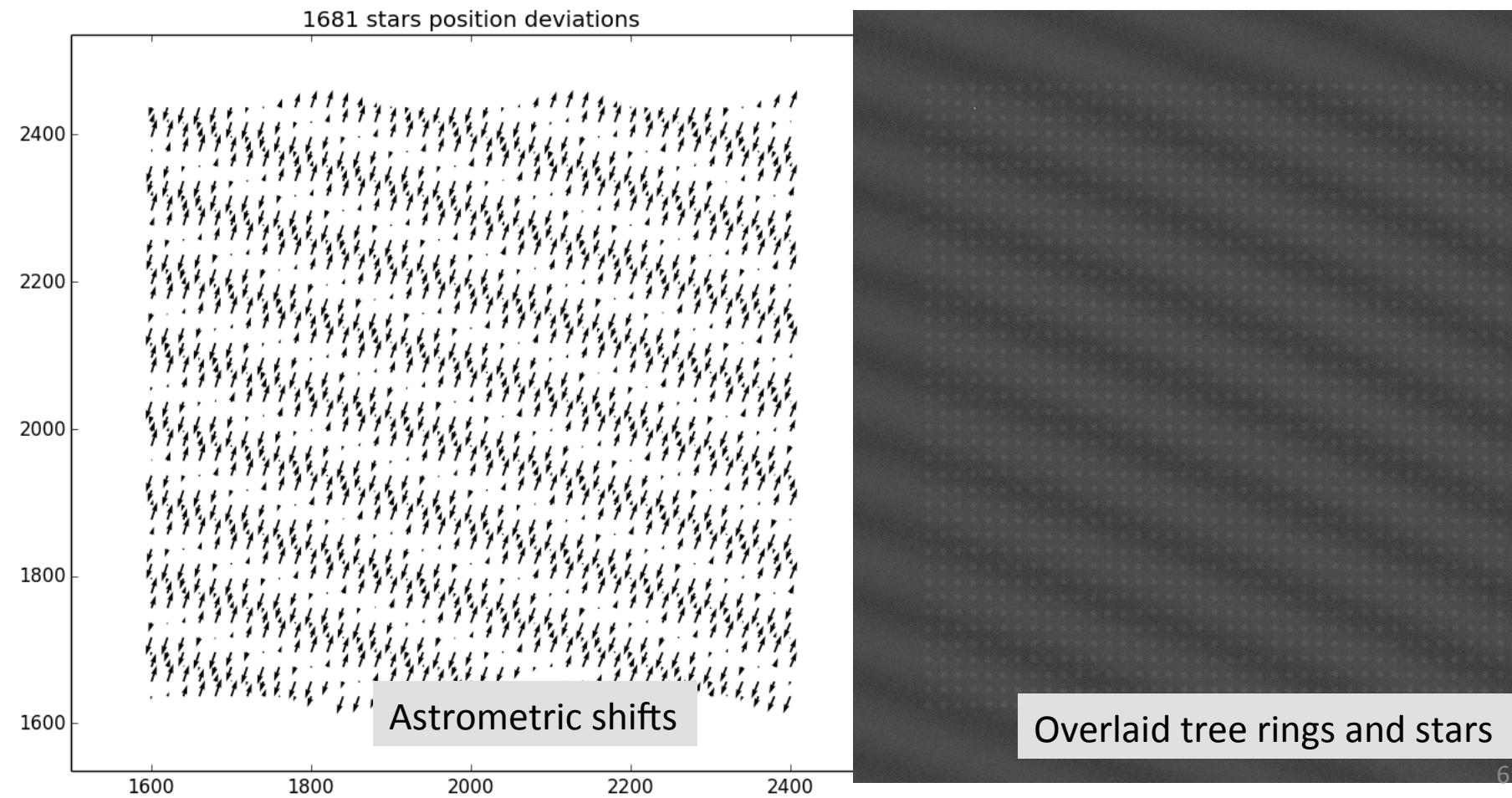
# Tree ring amplitude vs doping

- Varied silicon doping
- Fit sine amplitude to flats



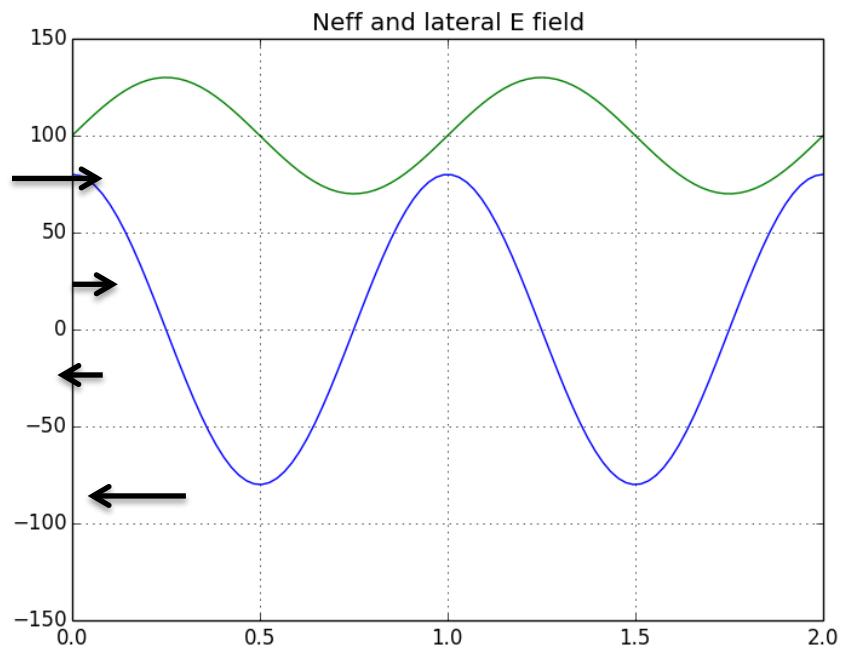
# Astrometric shifts

- Use sExtractor to find stars, measure centroids and second moments
- Plot arrows:  $(x,y)_{\text{simulated}} \rightarrow (x,y)_{\text{measured}}$



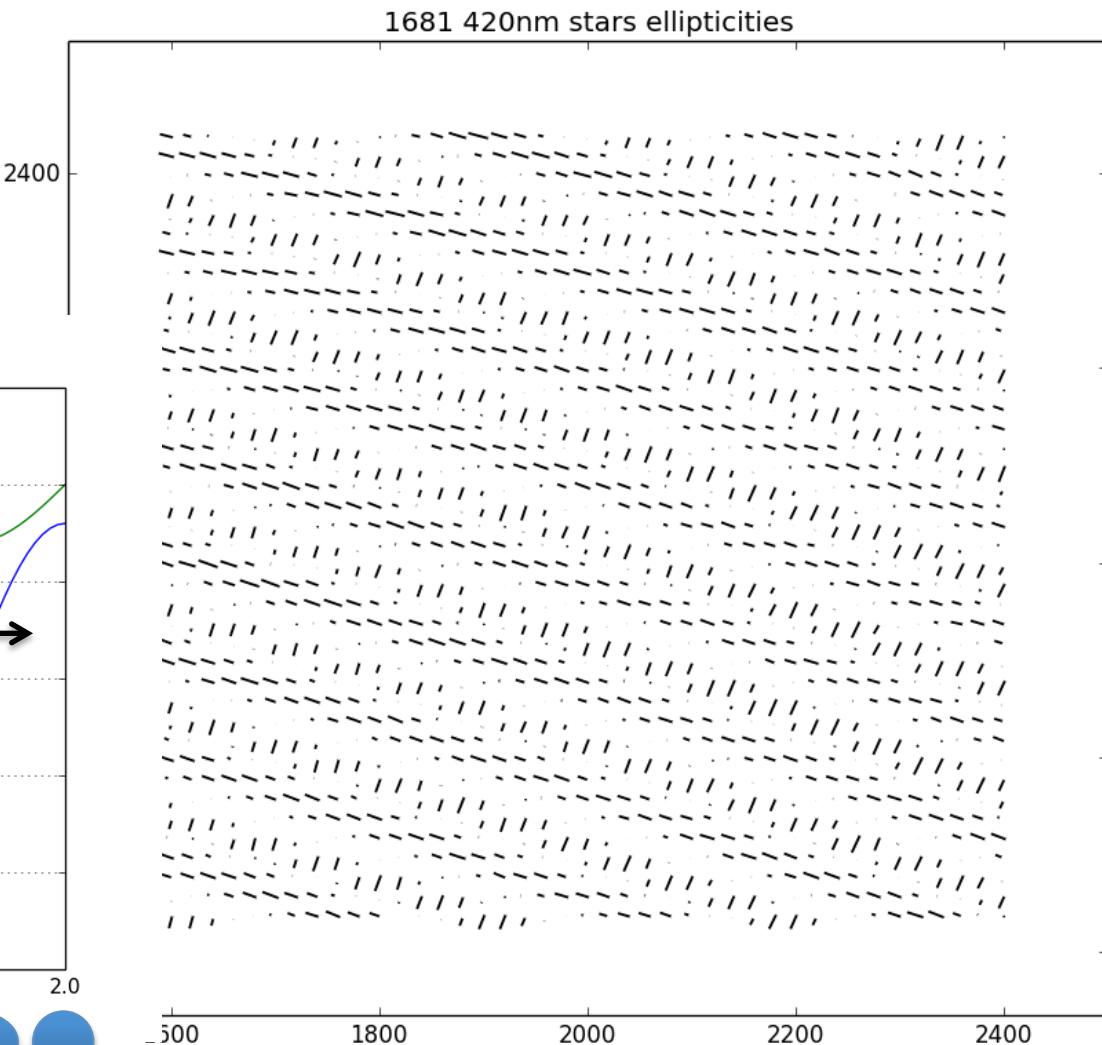
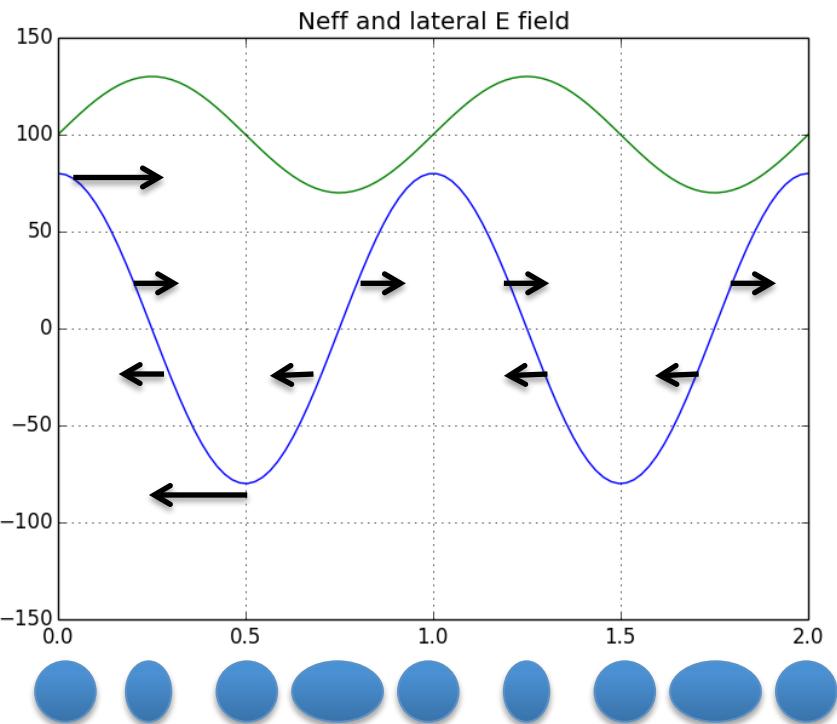
# Lateral E field in silicon

- $E_{\text{lat}} = 0$  in maxima and minima of  $N_{\text{eff}}$
- Maximum  $N_{\text{eff}}$  is brighter, larger positive fixed charge attracts hence shifts electrons

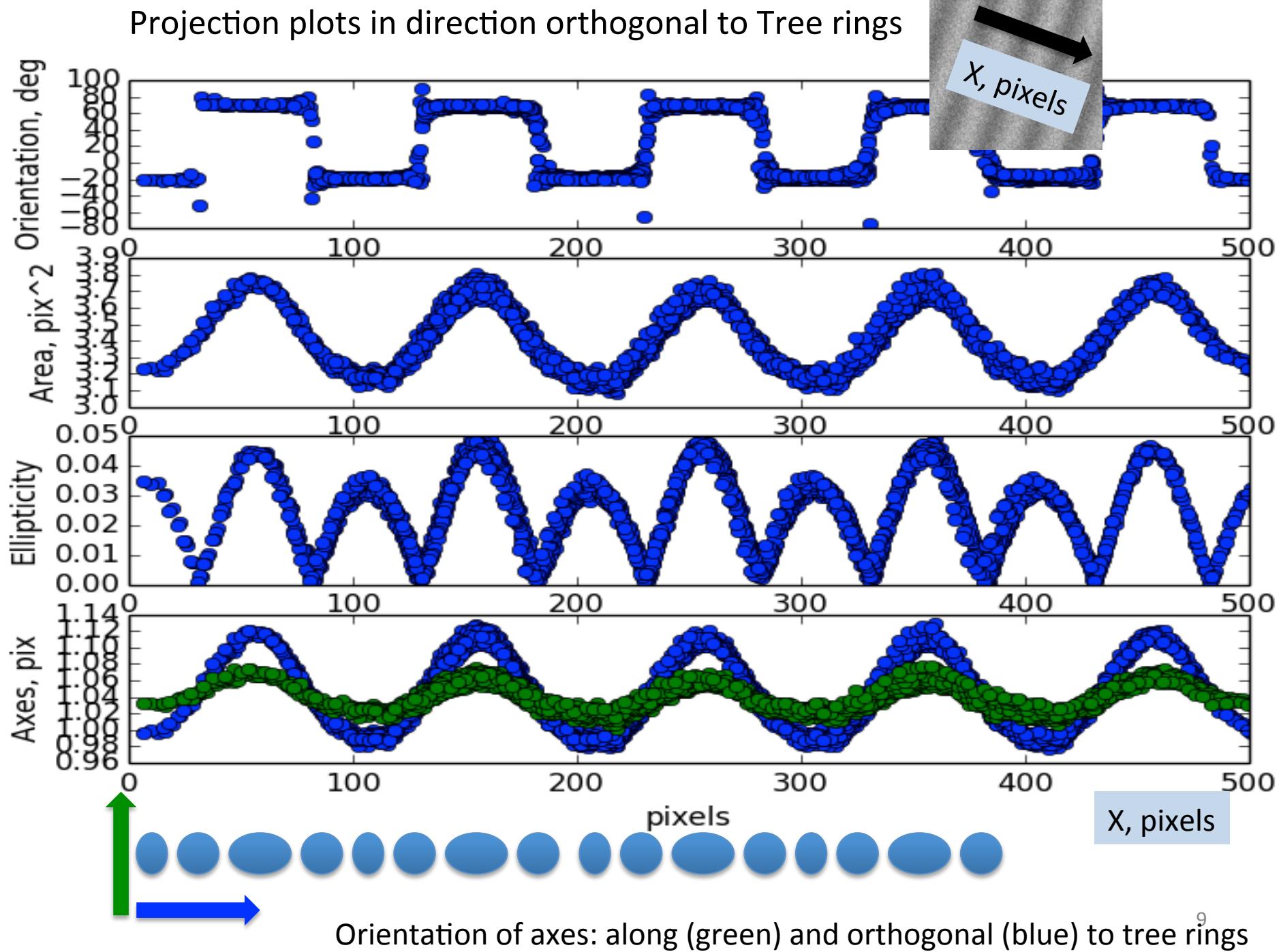


# Ellipticity

- Focussing / defocussing effects of tree rings lead to PSF oscillations

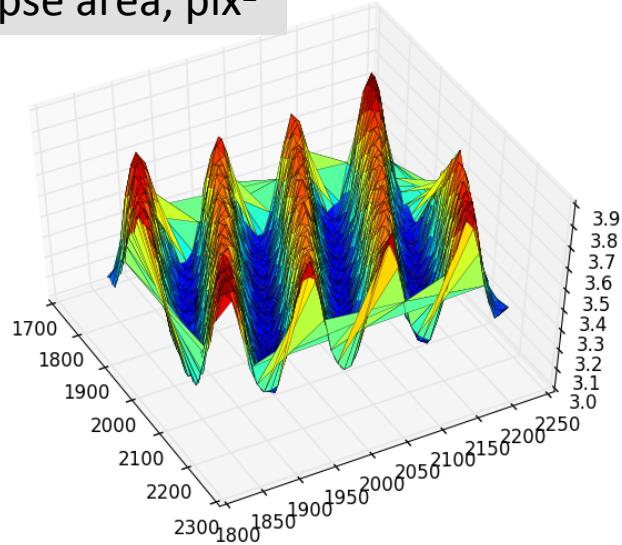


# Projection plots in direction orthogonal to Tree rings

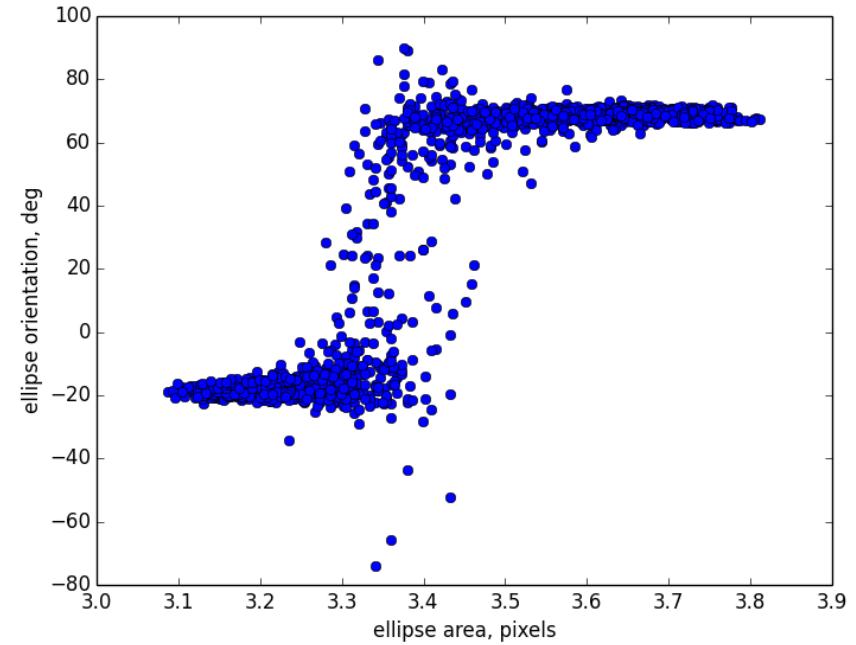
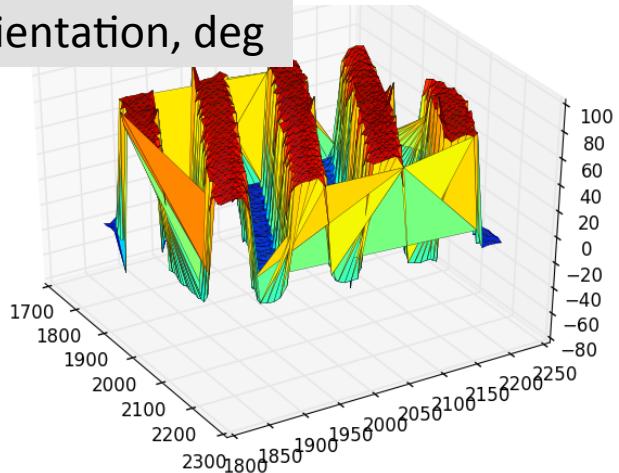


# PSF orientation vs PSF area

Ellipse area, pix<sup>2</sup>

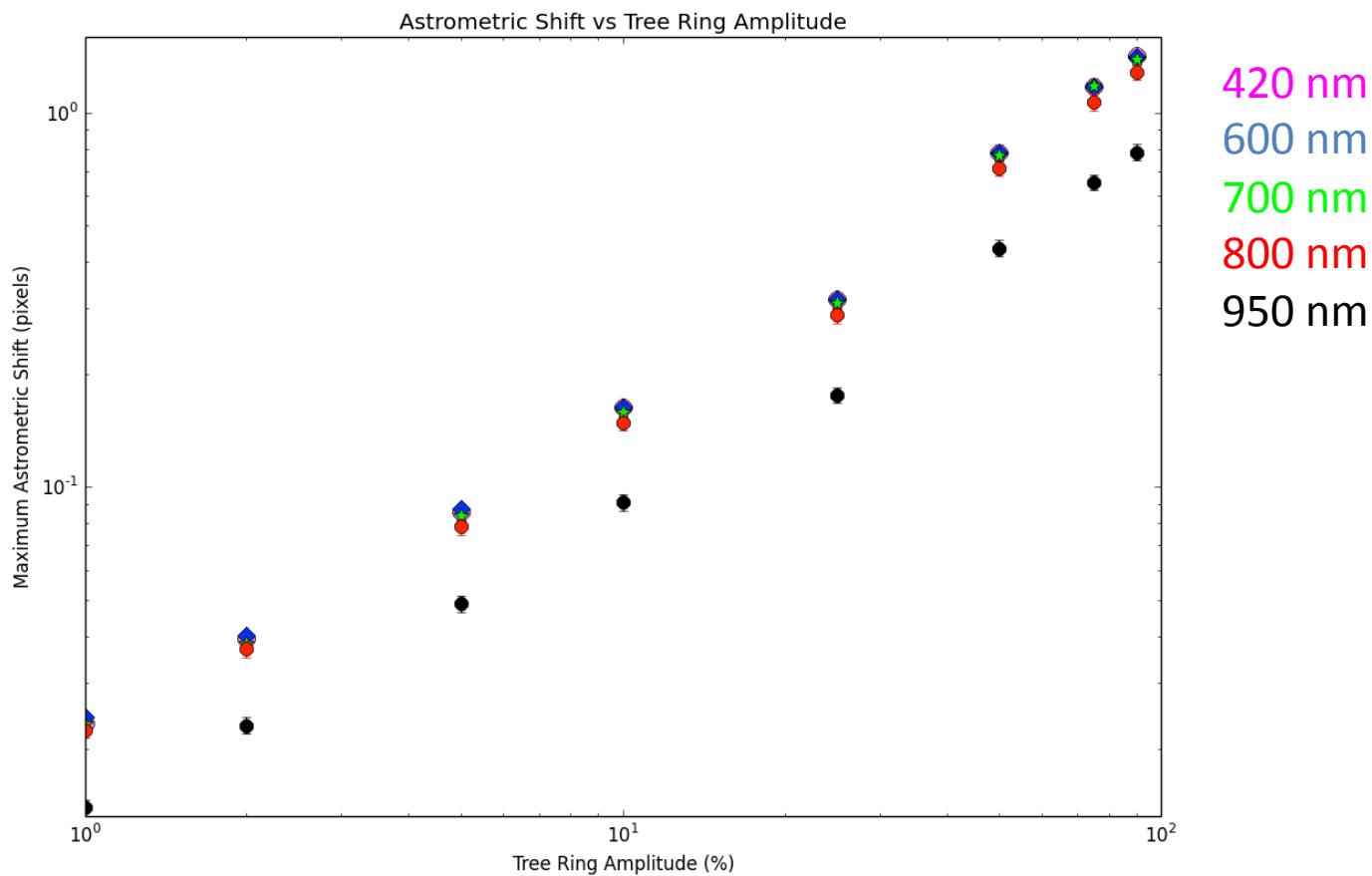


Orientation, deg



# Astrometric shifts vs tree ring amplitude and color

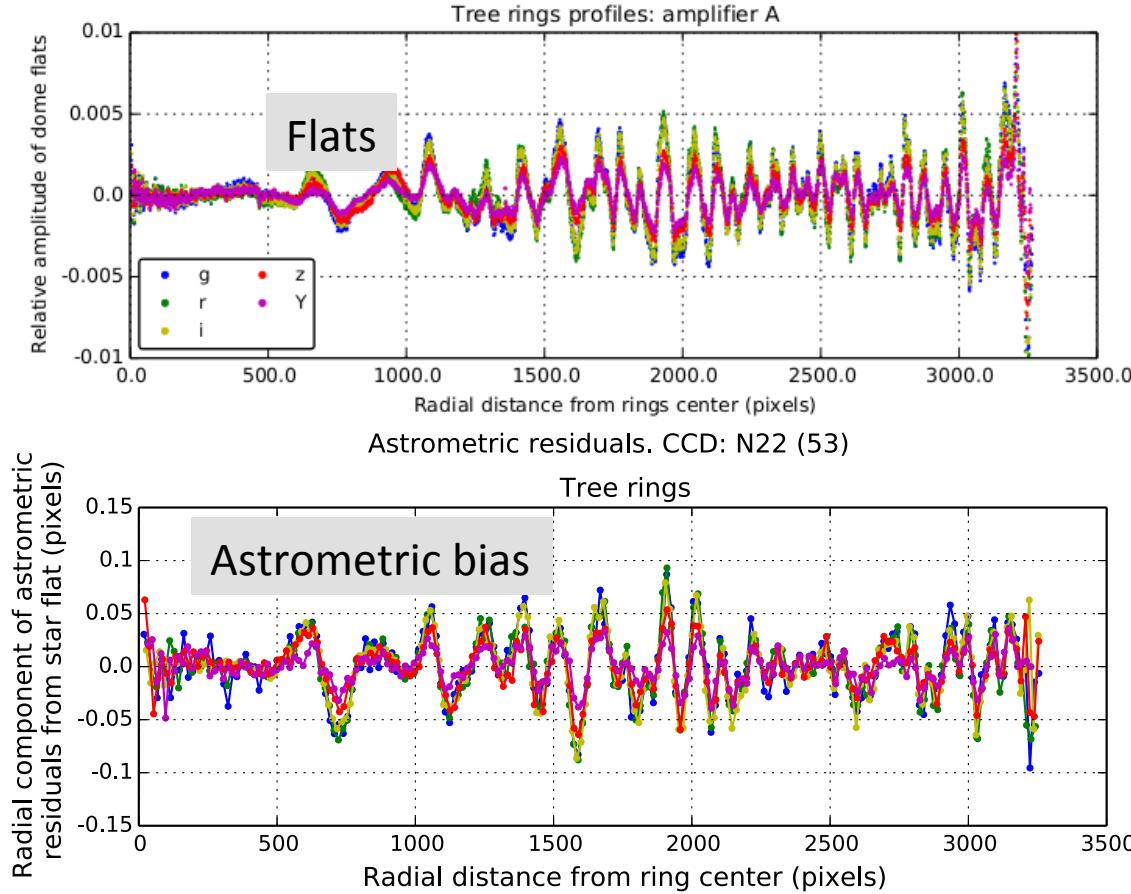
- IR is shifted less as expected



# DES astrometric shifts

Transverse electric fields' effects in the Dark Energy Camera CCDs

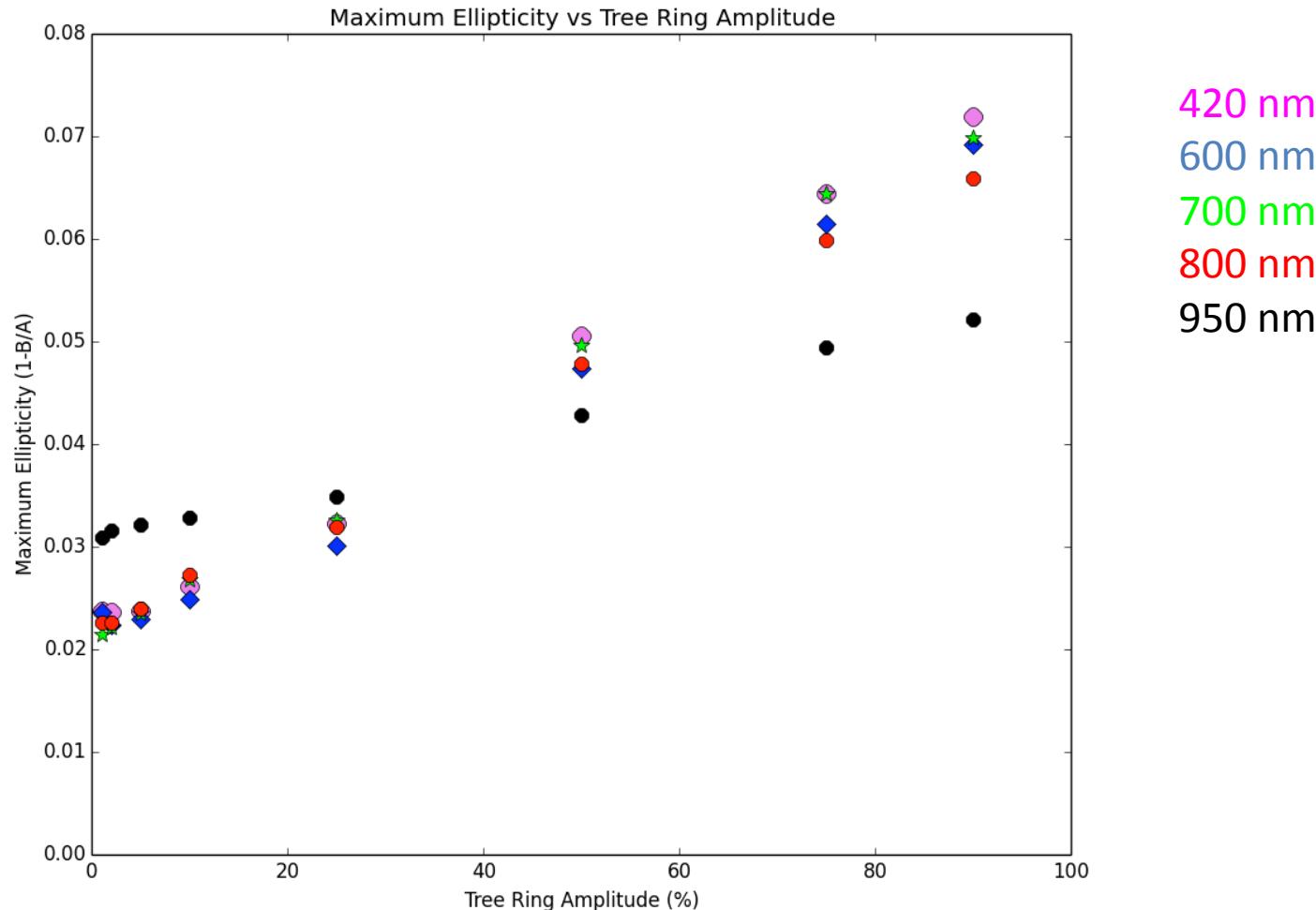
A. A. Plazas<sup>a†</sup>, G. M. Bernstein<sup>b</sup>, & E. S. Sheldon<sup>a</sup>



Our results are similar to DES but need further analysis to compare properly

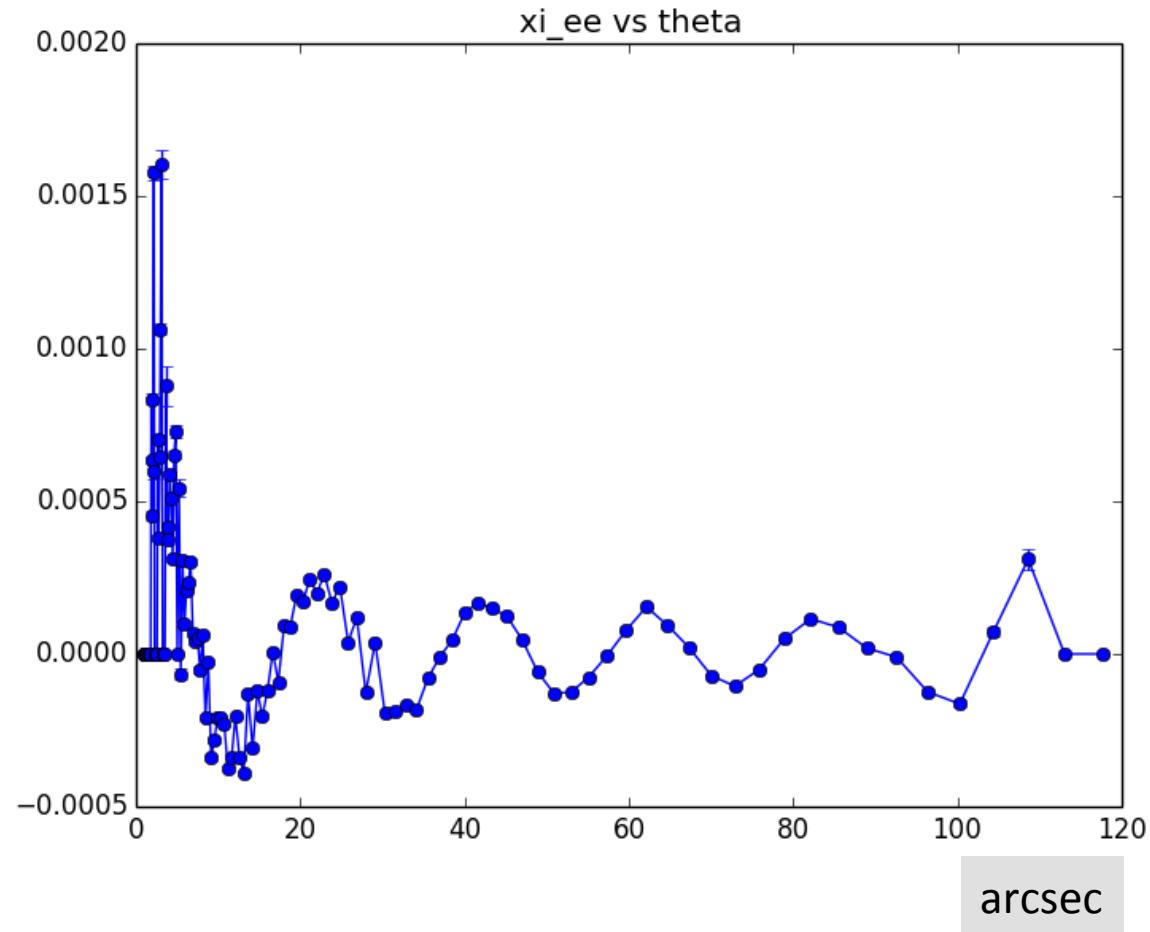
# Ellipticity vs tree ring amplitude and color

- IR has less dependence but
- Not sure why it's so large for small TR amplitude..
- Not sure why 950 nm is higher than rest for small amplitude..



# Correlation function

- First look at correlation function
  - Done using corr2 code by M.Jarvis
- Negative correlation between orthogonal ellipticities
- Positive correlation between aligned ellipticities
- Small area (400x400 pixels)
- Need to expand for larger areas



arcsec

# Summary

- Started a program of validation of sensor effects in Phosim
- First look at tree rings in Phosim, its intensity and color dependence
  - Results make sense in general, interesting effects in ellipticities
  - Will add optics and atmospheric effects
  - Will add other sensor effects (ex. BF effect)
  - Started to look at correlation functions and spurious shear due to sensor effects